PROTOCHARA, A NEW GENUS OF CHARACEAE FROM WESTERN AUSTRALIA

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PROTOCARRA, A NEW GENUS OF CHARACEAE FROM WESTERN AUSTRALIA

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During a post-seasonal excursion following the 1947 Australasian Science Congress in Perth, a remarkable number of the Characeae was collected by the first author from a small, shallow swamp on top of the peat-slope of the "break-away" country above the Irwin River, near Minginye, Western Australia. The habit of the plant, and the enormous size of the cells, was unlike any of the Characeae found in its localities. Most striking, however, was the complete absence of stipeoloid, bract-cell and bracteoles, a characteristic of no previously described genus of Characeae.

Nanekh Filaraki (1937) described (in a Hungarian journal) two Western Australian Chlorophytus from specimens sent to him by G. O. Allen. These specimens were from the collection of J. Groves at the British Museum, and had been collected originally by Miss N. T. Burbidge. Filaraki formed a new genus, Charias, on one of these specimens, although he had no fertile material. (See later notes.) The other specimen he referred to Nenella ptila as K. inflores Filaraki and Allen. Unfortunately, it has not been possible to examine material of N. inflores, as no specimens exist in Australian herbaria, and Filaraki's figures (reproduced in fig. 2) are inadequate in many details. From Filaraki's figures, however, N. inflores appears to be closely related to our own species, showing complete lack of stipeoloids, bract-cells and bracteoles, but differing in several important details (see later).

It is therefore proposed to find a new genus, Protochara, with P. australis r. sp. as the type, and to transfer N. inflores to this genus as P. inflores (Filar. and Allen) comb. nov.

Protochara australis r. sp.

Plant clonialous, totally eucarotic, to 10 cm. high, light green in colour, with no calcareous inclusions; attached by branched, colorless, several-celled rhizoid (fig. 1 A). Stem stout, simple or with a few auxiliary branches, bearing 4 to 7 whorls of branchlets; stem internodes 1 to 3 cm. long, 1-5-1-1 mm. thick. Branchless stout, slightly incurred, in whorls of 4 to 7, of 3 or 4 segments; terminal segment consisting of a small mucronate cell, 110-290 μ long, ringed at the base by 5 or 6 peripheral nodal cells (fig. 1 D); subterminal segment large, 2-3 mm. long, 1-1 mm. broad, asymmetrically inflated with the inflated side distant from the stem (fig. 1 A, B, D); intermediate segments 1-1 cm. long, almost as thick as the stem, slightly inflated when young. No ephialtes arising of 10 to 12 peripheral cells surrounding a plane of inner cells (fig. 1 C, D, G). Stipeoloids, bract-cells and bracteoles completely absent. Chloroplasts minute, forming vertical series in the cells (fig. 1 C).

Oogonia verticillate in the cells of the upper whorls of branchlets, or borne singly or geminately at the nodes of upper branchlets (fig. 1 A); each oogonium arising from a separate peripheral cell of a node. Mature oogonium (fig. 1 A, E) ovoid-cylindrical, 700-840 μ long, 600-780 μ wide; corona about 75 μ high, 225 μ broad, of 5 small mucronate cells, thickened at the apices; spiral cells showing 6 or 7 convolutions; each cell encircling the oospore slightly more than once. Oospore black, cylindrical-elongate when ripe, 490-560 μ long, 310-390 μ broad, showing 4 or 5 ridges (fig. 1 E, F).

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Fig. 1 *P. nutans* n. sp.

A. Apex of branch of a female plant, showing branch arrangement and position of oogonia. B. Antheridial plant showing general habit (natural size). C. Appearance of nodal cells with a bractlet removed, the main axes being vertical, and with longitudinal rows of chloroplasts in the cells. D. Tetrahedral microspore cell and substernal inflected cell of a bractlet, showing the peripheral cells of the nodae. E. Mature oogonium attached to peripheral cell of a node. F. Oospore with spiral ridges (not quite mature). G. Section of node of a bractlet, showing arrangement of central and peripheral cells. H. Antheridium.

p.c., peripheral cells of node. (All drawings by camera lucida.)
Fig. 2. *Pterochora insignis* (Filatov and Allen) comb. nov.

A. Part of a plant showing the whole of branchlets, together with oogonia and antheridia. B. End segment of a branchlet, showing the mature basal cells of the node. C. Mature oogonium. D. Minute oogonium. E. Antheridium.

(*After Filatov.*)

Antheridia borne similarly to the oogonia, octosicate, 800-1,150 μ in diameter.

As far as could be ascertained from limited material, the structure and development of vegetative parts and sexual organs agrees with that described for the *Characeae* by Fritsch (1935).

*Habitat*—In swampy areas of shallow water (10-40 cm. deep) on top of the peneplain of the "breakaway" country between Mingenew (about 15 miles from Mingenew) and the Irwin River coal seam, south-east of Geraldton, Western Australia.
Collected—28 August 1947.
From the same locality Lamprothamnium macrosporum (Braun) Opiz in Ch. nov. (1) and Nitella glabrata Braun were collected.

The type specimen (No. A 5,917 a) has been deposited in the herbarium of the Botany Department, University of Adelaide. Type specimens have been sent to the Herbarium of the Botany Department, University of Western Aus-


FIGOTRACHALIS INF.LATA (Filarski and Allen) comb. nov.
The following description of this species (as Nitella inf. lata) is given by Filarski.
Plantulae sonoante omnium coriaceae. Folia in verticillia 4-6, ciliciculata, segmentum quattuor bicellulare, cellula jpsa inf. at articulos unicae maximae


1. Inflata is dioecious, P. inflata monocious.
2. Corsorial cells of the oogonium are small in P. austrole, large and con-


3. The sub-terminal intercalary cells of the hypospodia of a. austrole show more pronounced asymmetry, and the lower cells are less inflated than in P. inflata.

terminal cell being small and inconspicuous. In *P. australis* a distinct ring of nodal cells occurs at the base of the terminal macroconidial cell, and it seems possible, in view of the close relationship between the two species, that close examination may show this to be the case in *P. trifascia*.

Why Thärlof placed his genus *Nitospora* is not clear. The one species of *Nitospora* (N. oblonga J. Groves, from Europe) is distinguished by the presence of very long, thick "bract-cells" which arise from the nodes of the branches and are almost as large as the ultimate branchlet segment (Groves and Bullock-Webster 1924). *"Starch starch,"* large, thickened, star-shaped nodes on the vaidalids are also characteristic of *N. oblonga*. The absence of bract-cells places both the Western Australian species in a distinct genus from *Nitospora*.

The corona of 5 cells surrounding the ascogonium places *Prostrophora* in the tribe Charae, as distinct from the Nitelloidea which have a corona of 10 cells. It is necessary, however, to modify the description of the Charae given by Groves and Bullock-Webster (1924) and Groves and Allen (1934), in that the branchlets normally produce bract-cells at their nodes, but not in *Prostrophora*.

The relationship of the genus of the Charae, including *Prostrophora*, is given in the following synopsis (modified from Groves and Bullock-Webster):

1. Stipulodes and bracteoles absent.
2. Bract cells absent. Branchlets 3 or 4 segments.

3. Origin of obscl. and sterculiae produced from separate peripheral cells of the node.

4. Origin of obscl. and sterculiae produced from the same peripheral cell of the node.

5. Origin of obscl. and sterculiae produced from separate peripheral cells of the node.

6. Origin of obscl. and sterculiae produced from the same peripheral cell of the node.

7. Origin of obscl. and sterculiae produced from separate peripheral cells of the node.

The genera of the Charae form an evolutionary sequence with *Prostrophora* as the most primitive, showing an advance in vegetative construction through *Nitospora*, where only bract cells occur, to *Laena*, where bract-cells and stipulodes occur. The Diploeiaceae tribe *Laena* represents the culmination of the evolutionary series, showing complete 3-ringed thallus and two well developed whorls of stipulodes.

The tribe *Nitelloidea* is best considered as a separate evolutionary series parallel to the Charae. No genus so far described provides a satisfactory link between the two tribes.

Besides the absence of stipulodes, bract-cells and bracteoles, *Prostrophora* shows another primitive character in the small number of convolutions (5 or 6) of the spiral cells of the conidiogenous *P. australis* in the conidiogenous segment of *P. australis* and *P. trifascia*. According to Groves and Bullock-Webster (1924) *Nitelloidea*.

(1) See Qvist, loc. cit.
obtains show about 9 convolutions, whereas most species of Clara show more than 12. fossil organisms attributed to Characea, judging from figures given, by Groves and Bullock-Webster, commonly show a relatively small number of convolutions (as low as 5 or 6).

The relatively few segments to the branches, and the general simplicity of the thallus, also point to the primitive nature of Protococcus.

The naming of most fossil Characeae remains (usually conoidea), as species of Clara, makes Clara in this sense a very much wider genus than the Clara of living species. It is quite likely that fossil conoidea would prove to belong to Protococcus if thallus structure were better preserved.

It is evident that Protococcus is the most primitive genus yet described of prequaternary Characeae, and appears to be more primitive than any genus of the Nitelloidaceae. The general habit of the plant, however, consists of the stem with whorled branches that is so typical of the group as a whole, and the conoidea and anthelia are of the highly specialized type common to all species. The relationship and position of the Characeae amongst other plants remains as obscure as ever.

LATIN DIAGNOSIS

PROTOCOCCUS a gen. nov.

Platulae omnino coriaceae. Stipuloidae, bractae-cellulæ et bracteola omnino absente. Monococce aut dicocce. Sogosa et anthelia a nodi pedicellOil cellulis suis. 3 cellulorum corona.

Protococcus maxillaris a sp. nov.

Platulae dicocce, omnino coriaceae, quam ad 10 cm. alt., subrigide, non inermentae: radiulae radials et multicoloreatis. Cellulae trascæ, singulas aut ramulorum verticillis 4-7, internodis cellulis 1-3 μm. longa, 6-9-13 μm. lata. Ramulis crassa laceris incrustata, in verticillis 4-7, quasque articulatim. 3-4; segmentum macroformis ultimorum longum 110-200 μm, perimereos soli cellulæ 5-6 in fascis; segmentum subulatum magnum non aequabilitur internalia; segmentum afferentis longum 2-1 μm, latum 1-14 μm. Nodi peripieros cellulis 10-12. Stipuloide, bractae-cellulæ et bracteola omnino absente. Sogosa in superum verticillorum ramularum axillibus verticillitis, notulæ aut biæ unius ramularum; a perimereos cellulis gospitis cellulis. Cogoriae oviformis-cylindriciformis longa 760-90 μm, lata 500-75 μm; teres cogoria alta circa 75 μm, lata 22 μm, composita cellulæ 5 parameris macroformis, cellulæ apertæ convoluta 67. Cogoria nigra, cylindriciformis-oblonga, longa 490-560 μm, lata 110-390 μm, riga 4-5. Anthelia nodos omnino similis ovis, octocellularis, diana 1,25 μm.

NOTES ON FILARSK'S GENUS CHARINA

In the same paper as Nitellopsis infixa was described, Filarski founded a genus Charina, based on the one species C. verticillata Fil. and Fil., from Wangan, Western Australia. None of the specimens on which the genus was named was fertile.

Filarski's reasons for founding a new genus are not clear, but were apparently based on the vegetative form of the plant. His figures show a slender, articulately branched plant bearing numerous whorled, 2-celled thallus. The occurrence of two- (sometimes more, rarely one) celled thallus such as those on the thallus is a characteristic feature of the Nitellopsis, as distinct from the
Characeae which bear only one-celled bracteoles on the branches. Filarski laid considerable stress on the apparent dimorphism shown by different branches (or plants?) of Chara; some branches bore only one-celled, blunt-ended, thalloid instead of the two-celled, mucronate type. A feature of some species of Nitschia, however, is that the terminal cell of the thallus is often deciduous, and this is probably the reason for the apparent dimorphism stressed by Filarski.

From the figures given, the general appearance of the plant and its vegetative construction offer not feature to exclude it from the genus Nitschia. In fact, Filarski adds a note that J. Groves had suggested the plant was close to Nitschia subhastata Brunn., and in the absence of fruiting material the naming of a new genus was hardly justified. Fertile material must be collected to prove whether Chara can be reduced or not, and it is to be hoped that both the species and Prutechera infest will be rediscovered by Western Australian collectors.

ACKNOWLEDGMENTS

The authors are indebted to Miss N. T. Burridge for information on the locality where she collected F. infusa and Chara eucalypti. Mr. G. G. Smith, Department of Botany, Western Australia, also collected some of the material of F. eucalypti.

REFERENCES

Filarski, M. 1932 "Idegenfődő Charafékelétek Határának. (Determinatio Characearum Extetarum)." Matematikai és Természettudományi Értesülő, 55, 476-495. (Budapest)

Fritsch, F. E. 1935 "The Structure and Reproduction of the Algae." 1


Gnasp, J., and Bullock-Webster, G. R. "The British Charophyta," 1, (1920), 2, (1924)
The collection of marine algae listed below was made by Mr. J. H. Willis, Botanist on the 1906 Australian Geographical Society expedition to the Archipalego during December 1906. Apart from a few specimens from each genus, all were collected from the gird. A small collection from near Jasper Bay on the mainland, is also included.

This list, as far as I am aware, provides the first record of marine algae from the Hawaiian Archipelago, and although the collection is a recent one it does widen our knowledge of the distribution of some southern Australian species.

The following species were previously known only from the southern half of the southern Australian region: *Sphacelaria helvola*, *Paralia axillaris*, *Sargassum criptophyllum*, *Ceramium californianum*, *Dictyota serrata*, *Intertetranea ramosa*, *Kokioina clavata* and *Polysiphonia discophora*. These are listed with preceding *et*.

The following species, *Ceramium portulaeforme*, *Ceramium brevis*, *Cystophora atropurpurea* and *Lasioseira subulata* are of western Australian origin, whilst the remaining are either generally distributed around southern Australia or are cosmopolitan.

Specimens of all species have been deposited in the Algal Herbarium of the
Department of Botany, University of Adelaide. Some specimens have been deposited in the National Herbarium, Melbourne.

The information below is thus used by Worsley 1908, where additional references will be found. The renewal of old names is tedious. "Ulva" has been deleted from all citations of Figueiredo-Rigby and North Twin Peaks Island.

**Chlorophyta**

**Ulvales**

*Ulva lactuca* (L.) Gmelin, *Ulva prolifera* (L.) Gmelin. A few small specimens of both species.

**Cladophorales**

*Cladophora* subulata var. *brevis* (L.) Gmelin. A few small specimens of both species.

**Siphonocladales**

*Dictyota* serrata (Gmelin) Kützing. A few small specimens of both species.

**Siphonales**

*Codium* fruticosum (L.) C. Agardh, *C. kochii* var. *longum* (Kützing) C. Agardh. A few small specimens of both species.

**Phaeophyta**

**Sphacelariales**

*Phaeophila* kochii (Kützing) Kützing. A few small specimens of both species.

**Dictyotales**

*Dictyota* brevisetum (Kützing) A. E. Smith, *D. prolifera* (L.) C. Agardh. A few small specimens of both species.

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CORNALIACEAE (contd.)

Mycophylla cathartica (Leenh.) N. F. Brong. *Anabryza cathartica*, Harvey 1847, 94, pl. 93—Figure EIGHT. Crowned and Black Skunks in California Bay.

Mycophylla cathartica (Leenh.) N. F. Brong. *Anabryza cathartica*, Harvey 1847, 94, pl. 93—Figure EIGHT. Crowned and Black Skunks in California Bay.

Myxophyllum habitatum (Hedw.) E. S. Bot. Hymenostomata 1893, 157. Myxophyllum habitatum Harvey 1847, 93—Figure EIGHT. Crested and Black Skunks in California Bay.

GRAPELOPHIACEAE

Cornutopsis slimani (Harvey) Slime. *Acrispina slimani* Harvey 1896, pl. 121—Figure EIGHT and North Twin Peaks.

GIGARTINALES

PLOCAMIAEAE

Planozonaria saccata (Harvey) J. Agardh ex Cav. 1864, 34. Lona & Pears 1907, 215—Figure EIGHT.

SOLIERIACEAE

Selachia robusta (Grev.) Krupa 1932, 18. Selachia robusta Harvey 1896, pl. 160—Figure EIGHT. Robust, north-west of San Francisco Bay.

RHODOMONIDAE

Rhodomonis feeding Harvey 1856, pl. 54. Lona & Pears 1907, 171, f. 42—Figure EIGHT. Maleka, north-west of San Francisco Bay.

HYPOXACEAE

Hyposia scolota (J. Agardh) 1935, 444. S. Ven. 1907, 456—Figure EIGHT. Maleka, north-west of San Francisco Bay.

DICRANJACAE

Desmogonem gasellai (C. E. Adams). Harvey 1856, pl. 120. Lona & Pears 1907, 137, f. 29—North Twin Peaks.

RHODYMEMIALES

Rhodymenia elata (C. E. Adams). "Acrispina elata", Harvey 1896, pl. 16. Lona & Pears 1907, 215—Figure EIGHT.

CERAMIALES

Ceramiales


RHODOMERACEAE

1. Phyllophorus harveyi (C. E. Adams). Lona & Pears 1907, 246. Harvey 1896, 183—Figure EIGHT. (A. Anemone) and Clear Lake.

2. Phyllophorus harveyi (C. E. Adams). Lona & Pears 1907, 246. Harvey 1896, 183—Figure EIGHT. (A. Anemone) and Clear Lake.

3. Phyllophorus harveyi (C. E. Adams). Lona & Pears 1907, 246. Harvey 1896, 183—Figure EIGHT. (A. Anemone) and Clear Lake.

North Twin Peaks.

4. Phyllophorus harveyi (C. E. Adams). Lona & Pears 1907, 246. Harvey 1896, 183—Figure EIGHT. (A. Anemone) and Clear Lake.
Cyphulaea variegata (Mert.) J. Ag. - a brown, elongated, seldom bearing vehicle.

Photo: R. D. Lee (material from Mount Martha, Victoria)